

CLAIMS

That which is claimed is:

- 5 1. A method for reducing and/or removing nitrogenous products from a marine recirculating aquaculture system, the method comprising:

housing an aquatic species in a rearing tank containing salt water medium, wherein the salt water medium comprises sulfates and is contaminated with at
10 least ammonia and nitrates;

transferring the salt water medium from the rearing tank through a downstream filtering means for separating solid materials from the salt water medium;

15 transferring separated solids and at least some of the salt water medium to a sludge holding tank, wherein the sludge holding tank comprises a media substrate for growth of anaerobic microorganisms active in sulfate reduction;

20 retaining the separated sludge and salt water medium in the sludge holding tank a sufficient time for generating sulfides through metabolic reduction of sulfate in the salt water medium by the anaerobic microorganisms active in sulfate reduction;

25 transferring the salt water medium comprising the sulfides from the sludge holding tank to a denitrification unit positioned downstream from the sludge tank, wherein the denitrification unit comprises a fixed bed of media substrate for growth of anaerobic microorganisms active in sulfide oxidization and nitrate reduction;

30 retaining the salt water medium in the denitrification unit for a sufficient time for oxidizing sulfides to sulfates and reducing nitrates to nitrogen gas by the microorganisms active in sulfide oxidization and nitrate reduction;

transferring the salt water medium from the denitrification unit to a nitrifying moving bed bioreactor (MBB) positioned downstream from the denitrification unit, wherein the MBB comprises moving suspended media substrate for growth of aerobic microorganisms active in nitrification;

retaining the salt water medium in the MBB for a sufficient time to reduce ammonia concentration in the salt water medium; and

transferring the salt water medium from the MBB to the rearing tank for recirculation.

2. The method according to claim 1, wherein the microorganisms active in sulfate reduction comprises bacteria from the genera *Desulfobacter*, *Desulfobacterium*, *Desulfovibrio* or *Desulfotomaculum*.

3. The method according to claim 1, wherein the microorganisms active in sulfide oxidation/nitrate reduction comprises a bacteria from the genera *Thiobacillus* or *Thiomicrospira*.

4. The method according to claim 1, wherein the media substrate in the sludge holding tank is fabricated from polyethylene.

5. The method according to claim 1, wherein the flow rate through the components including the rearing tank, denitrification unit, filtering means or MBB from about 0.1 m³/hr to about 10 m³/hr.

6. The method according to claim 5, wherein the flow rate is the same for all components or different for each component.

7. The method according to claim 1, wherein the pH in the sludge holding tank and denitrification unit is maintain in a range from about 6.8 to about 9.

8. The method according to claim 7 wherein the pH in the sludge holding tank and denitrification unit is maintain at above 7.

9. A marine recirculating aquaculture system, the system comprising:

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at least one aquatic species rearing tank, wherein the rearing tank comprises a salt water medium;

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a sludge holding tank positioned downstream from the rearing tank and in fluid communication therewith, wherein the sludge holding tank comprises a media substrate for growth of microorganisms active in sulfate reduction;

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a denitrification unit positioned downstream from the sludge tank and rearing tank and in fluid communication therewith, wherein the denitrification unit comprises a media substrate for growth of anaerobic microorganisms active in sulfide oxidization and nitrate reduction; and

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a nitrifying moving bed bioreactor positioned downstream from the denitrification unit and upstream of the rearing tank and in fluid communication therewith, wherein the nitrifying moving bed bioreactor comprises a media substrate for growth of microorganisms active in nitrification.

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10. The system according to claim 9, further comprising a drum screen filter positioned between the rearing tank and the sludge tank and in fluid communication therewith, wherein the drum screen filter separates solids transferred from the tank in the recirculating salt water medium with subsequent transference of such separated solids to the sludge tank.

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11. The system according to claim 9, wherein the nitrifying moving bed bioreactor comprises

an inlet and outlet for movement of the salt water medium

therethrough;

a suspended media substrate for growth of aerobic microorganisms active in nitrification, wherein the suspended media is kept in motion by the movement of the salt water medium; and

aeration means to inject air or oxygen into the salt water medium for effective aerobic nitrification by the microorganisms.

10 12. The system according to claim 9, wherein the media substrate comprises polyethylene beads.

13. The system according to claim 9, further comprising an automatic monitor and control system communicatively connected to the different system components.

15 14. The system according to claim 9, wherein the denitrification unit is an upflow fixed substrate column.

15. The system according to claim 10, further comprising a conduit system for connecting the rearing tank, drum screen filter, sludge holding tank, denitrification unit and moving bed bioreactor.

16. The system according to claim 9, wherein the moving bed bioreactor is an upflow column.

25 17. The system according to claim 9, further comprising a plurality of sampling pumps and/or in line monitoring devices located in at least the rearing tank, drum screen filter, sludge holding tank, denitrification unit and moving bed bioreactor to measure water temperature, oxygen content, pH, ammonia, nitrite, nitrate, sulfate, and/or sulfide levels.